

# ***Alaska Department of Fish and Game***



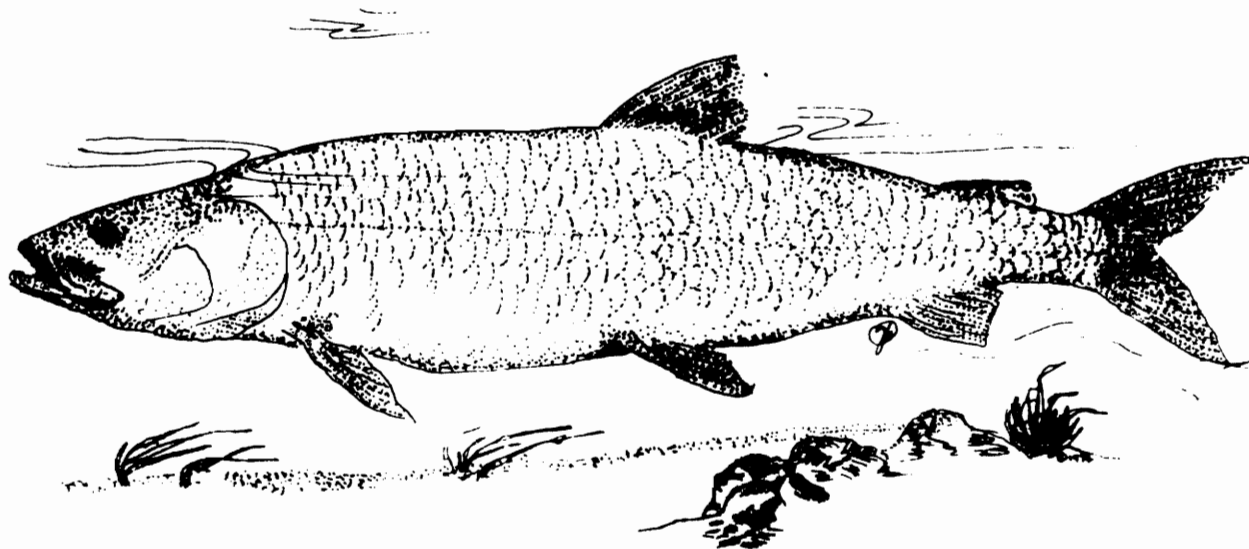
JAMES W. BROOKS, COMMISSIONER

**Division of Sport Fish**

**FEDERAL AID IN FISH RESTORATION**

## **STUDY R-II A LIFE HISTORY STUDY OF SHEEFISH AND WHITEFISH IN ALASKA**

**KENNETH T. ALT**



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STATE OF ALASKA  
WILLIAM A. EGAN, GOVERNOR



Annual Performance Report for

A LIFE HISTORY STUDY OF  
SHEEFISH AND WHITEFISH IN ALASKA

by

Kenneth T. Alt

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RESEARCH PROJECT SEGMENT

State: ALASKA Name: Sport Fish Investigations of Alaska.

Project No.: F - 9 - 6

Study No.: R - II Study Title: A LIFE HISTORY STUDY OF SHEEFISH AND WHITEFISH IN ALASKA.

Period Covered: July 1, 1973 to June 30, 1974.

ABSTRACT

Sheefish, Stenodus leucichthys, stocked in Four Mile Lake reached a mean length of 525 mm at age V.

Three hundred eighty-six sheefish were tagged in middle Yukon River tributary streams in 1973. Twenty-three tags were recovered, including 3 tagged in 1971, 13 tagged in 1972, and 7 tagged earlier in 1973. Recoveries were mainly in the same areas as tagged.

Spawning ground surveys located small numbers of pre-spawning fish in the upper Nowitna and upper Porcupine rivers. Actual locations of spawning grounds were not found. Spawning ground locations of mature sheefish passing through Rampart are evidently not in Hess Creek or Ray and Dall rivers. These fish probably spawn in the main Yukon River. Age and growth studies were conducted on fish from the Nowitna, Ray, and Dall rivers and Hess Creek. Growth patterns indicate Nowitna River fish were the fastest growing.

Electrophoretic studies of sheefish from the lower, middle, and upper Yukon River showed no evidence for or against existence of different populations in the river.

Three sheefish taken in the Porcupine River on September 22, 1973 had been feeding, the first Alaskan recorded incidence of sheefish feeding prior to spawning.

The taxonomic history of humpback whitefish, Coregonus pidschian, in Alaska is reviewed. Modal counts of Alaskan humpback whitefish gill rakers ranged

from 21 in the Holitna River to 25 in Crosswind Lake. The breakdown of the humpback whitefish into three distinct species does not appear to be warranted by available evidence; Coregonus pidschian is suggested as the species name of humpback whitefish in Alaska.

## RECOMMENDATIONS

It is recommended that:

1. Sheefish rearing studies be expanded.
2. Spawning ground surveys of middle Yukon River sheefish concentrate in area above Rampart.
3. Food habits and tagging studies on middle Yukon River fish be completed during 1974.
4. Sheefish tag and recovery efforts be initiated on the upper Yukon River to determine if there is interchange between the Porcupine River and upper Yukon River.
5. Whitefish studies concentrate on life history aspects including food habits, age and growth, movements, and population dynamics.

## BACKGROUND

The sheefish, Stenodus leucichthys, lake and river adaptability study is concerned with egg takes, following the growth of sheefish stocked in Alaskan lakes, and developing methods of rearing sheefish to fingerling size for stocking in rivers. Surveys of new waters for possible introduction of sheefish also fall under this study. Egg takes have been fairly successful in past years but problems exist in transporting eggs to the hatchery. Hatching success varies from 0 - 65% for the 6 years of the project. The largest problem is in rearing of fry. For various reasons the only populations that have been established are in Four Mile Lake near Tok and Engineer Hill Lake on Eielson Air Force Base.

The study of the movements and general life history of sheefish in the tributaries of the middle Yukon River (mouth of Koyukuk River to Ft. Yukon) began in 1971. During this time, sheefish have been tagged at the Nowitna River, Rampart, Hess Creek, Ray River, Dall River, and Porcupine River. Spawning ground surveys have been conducted in the Nowitna and Porcupine rivers and the vicinity of the main Yukon River between Rampart and Stevens Village. Spawning fish have been located in small numbers but definite location of spawning grounds are still unknown. Age and growth studies of fish from all tributary rivers are now completed. Food habits information has been collected. Taxonomic studies are now completed. Another year of tag recoveries, location of spawning grounds, and collection of food habits data should complete the major portion of this project.

The whitefish taxonomy and distribution study is nearly completed and the three years of study have resulted in obtaining general information on the taxonomy and distribution of the major whitefish in Alaska (humpback whitefish, Coregonus pidschian; broad whitefish, C. nasus; round whitefish, Prosopium cylindraceum; least cisco, C. sardinella; arctic cisco, C. autumnalis; and Bering cisco, C. laurettae).

In addition, information on age and growth, food habits, spawning movements and population dynamics has been collected.

Research papers published or in the process of being published during 1973-1974 include: Age and growth of inconnu in Alaska. J. Fish. Res. Bd. Canada Whitefish of the Colville River. J. Fish. Res. Bd. Canada; Contributions to the biology of the Bering Cisco. J. Fish. Res. Bd. Canada; Age and growth of broad whitefish in Alaska. (*in process*), Inconnu tagging studies in Alaska, 1961 - 1971 (*in process*); and Sheefish bibliography (*in process*).

## TECHNIQUES USED

Sheefish for egg takes were captured in the Koyukuk River by hook and line and from the Yukon River at Rampart using a fishwheel.

Sheefish for the middle Yukon tagging study were collected by monofilament and multifilament gill nets of 2, 2.5, and 3 inch bar mesh ranging from 80 - 100 feet in length. One monofilament and one multifilament variable mesh gill net were also used. These sinking nets were modified with floats so they fished 0.5 meter under the water. This modification allowed debris to float over the net. Fish captured were tagged with internal anchor tags. Nets were checked every three to four hours to minimize mortality. A fish-wheel at Rampart was rented to capture sheefish for tagging on the upstream spawning migration in the Yukon River in September. A live box was constructed on the wheel and the box was checked three times a day. Tag recoveries were made mainly by the tagging crew and also by subsistence and sport fishermen in the middle Yukon River.

Meristic counts on sheefish and humpback whitefish gill rakers were made in the field on the excised first left gill arch. In the analysis of data, both mean total counts and modal counts, as used by McPhail and Lindsey (1970), are also given. Gill raker data were analyzed using a Friden #1155 desk computer.

A sample of scales from sheefish of various middle Yukon River streams was selected to include fish from all length groups. Scales were collected during the 1971 - 1973 field seasons.

Back-calculated age and growth data for sheefish were analyzed using an IBM 360 computer. The Modified Doolittle Method (Draper and Smith, 1966) was used to compare growth.

Electrophoretic protein analysis of sheefish muscle tissue was conducted by Dr. J. W. Clayton of the Freshwater Institute, Winnipeg, Canada.

## FINDINGS

### R - II - A Sheefish Lake and River Adaptability Study

#### OBJECTIVES

1. To find a method of rearing sheefish to fingerling size.
2. To determine suitability of new lakes and streams for sheefish.

#### Egg Takes

Approximately one million eggs were taken from sheefish at Hughes on the Koyukuk River on October 1, 1973. The fish were slightly green when the eggs were taken. The eggs reached the Fire Lake Hatchery within one day. All eggs were dead by late October.

Approximately 200,000 sheefish eggs were taken at the Rampart fishwheel on the Yukon River on September 25. An airplane did not arrive for three days and the eggs perished. The upstream migration ceased on September 27, so no more eggs could be taken.

#### Four Mile Lake

Four Mile Lake on the Taylor Highway was test netted on July 6, 1973 (2 net nights) and on December 21, 1973 (2 net nights). Three sheefish were taken in July with a mean length of 509 mm (range 484 - 523 mm) and a mean weight of 1.7 kg (range 1.3 - 2.0 kg); and four were captured in December with a mean length of 525 mm (range 517 - 535 mm) and a mean weight of 2 kg (range 1.9 - 2.2 kg).

The mean length of the 1972 catch (n=4) was 466 mm and the mean weight was 1.3 kg. The increased rate of growth experienced in 1972 - 1973 could have been partly due to the availability of silver salmon, *Oncorhynchus kisutch*, as food. Silver salmon fingerlings (9,800) were stocked in the lake in 1972. The salmon averaged 156 mm in length in July 1973 and 281 mm by December 1973. By late 1973, however, the salmon had probably exceeded the size at which they could be utilized by sheefish. Examination of stomachs of fish taken in December showed freshwater shrimp, *Gammarus* sp., and mayflies larvae to make up most of the diet. A few chironomids and aquatic beetles were eaten. Gonads showed some development, with mean egg diameter 1.3 mm. These fish are from a June 1968 plant of 4,000 fry.

One of the seven sheefish (fork length 481 mm) was four years old. This is the first capture of the February 1969 stocking of approximately 80,000 fry.

#### Lost Lake

Test netting and seining in Lost Lake during the summer and fall of 1973 failed to capture any of the 44,000 sheefish fry planted in February 1973.

R - II - C Movements, Age and Growth, Spawning Ecology, Population Dynamics, and Utilization of Sheefish in the Middle Yukon River and Norton Sound Streams.

OBJECTIVES

1. To determine movements and population status of sheefish in the section of the Yukon River drainage from the mouth of the Koyukuk River upstream to Fort Yukon.
2. To study the spawning ecology of sheefish in the middle Yukon River tributaries.
- 3.. To compile data on age and growth, food habits, and population dynamics of middle Yukon River sheefish.
4. To determine sport and subsistence utilization of sheefish in Interior and Arctic streams.

Middle Yukon Tagging Study

In 1973, 386 sheefish were tagged, including 148 in the Nowitna River, 65 in Hess Creek, 28 in the Ray River, 34 in the Porcupine River, and 111 at Rampart on the Yukon River. Fish were tagged in the Nowitna, Ray, and Porcupine rivers, and Hess Creek in late May and June, and at Rampart in September. In September, six were tagged in the upper Porcupine River and 15 in the Yukon River in the vicinity of the Yukon River haul road. Twenty-three tagged fish were recovered in 1973 including 3 tagged in 1971, 13 tagged in 1972, and 7 tagged earlier in 1973. Seven recoveries were made by subsistence fishermen and the others by the Fish and Game tagging crew. In general, recoveries were made in the same vicinity as tagged except that a sheefish tagged at the mouth of the Nowitna River on May 29 was recaptured on September 7, 120 km up the Chatanika River where it apparently was going to spawn. None of the 141 fish tagged at the Rampart fishwheel in September of 1972 were recovered in 1973.

In an effort to follow the movement of the tagged sheefish passing through Rampart, test netting was conducted in the main Yukon River and tributaries between Hess Creek and 32 km above Stevens Village September 9 - October 1. Sixty-two sheefish were captured of which 15 were tagged and 47 were autopsied to determine sexual condition. No large spawning populations or groups were located nor was there any indication as to possible location of spawning grounds. No mature sheefish were taken in nets at the mouth of Hess Creek (2 net nights), or 2 km upstream (3 net nights), or at the mouth of Dall River (2 net nights). Eighteen of 23 sheefish caught at the mouth of Ray River (12 net nights) were examined. Six were in spawning condition with the remainder immature and non-consecutive spawners. Gill nets set 1 km up the Ray River (5 net nights) failed to take any sheefish.

Thus it is probable that no sheefish spawn in Hess Creek, Ray, or Dall rivers, or else they enter the streams after October 1. Since no concentrations of spawning fish were found at the mouths of these streams, I consider it unlikely that they would enter either Ray River, Hess Creek, or Dall River.

The 48 sheefish in which sex and maturity could be determined include 14 females (4 immature, 5 ripe, and 5 non-consecutive spawners) and 34 males (5 immature, 27 ripe, and 2 non-consecutive spawners or spent fish). The ripe fish had ceased feeding, but the immatures and non-consecutive spawners were feeding.

The sheefish had evidently not spawned by the time the project was terminated September 30. Milt was running freely from males the entire last week of September and eggs could easily be expressed from females. This indicates that spawning time was near and also that these sheefish spawn somewhat later than sheefish in other Alaskan streams.

There is a strong possibility that spawning occurs in the main Yukon River. This normally turbid stream clears up considerably by early October. No spawning activity was observed in 1973.

Only two tagged fish were recovered in the middle Yukon River during the test netting operation, but neither were from the 141 sheefish tagged at the Rampart Fishwheel in 1972, nor from the 111 sheefish tagged there in 1973. The peak of the 1973 run was considerable earlier than 1972 and many of the spawning fish probably had already passed upstream by September 12. Two mature sheefish (female - 80 cm and male - 76 cm) were captured in the main Yukon River 4 km above the mouth of Hess Creek on August 24 (one net night) and residents of Rampart mentioned that they had taken considerably more sheefish at this early date in 1973.

#### Rampart Fishwheel

One hundred thirty-four sheefish were taken in a fishwheel operating in the Yukon River at Rampart between August 25 and September 29. Fairly high catches were made during the first days of operation, with a lull in early September and then increased catches starting in mid-September. This pattern was similar to 1972 except that very few were taken in August of 1972 (Alt, 1973). The mean fork length for 79 males was 731 mm (range 480 - 855 mm) and for 50 females was 815 mm (range 665 - 940 mm). Males averaged 4.02 kg (range 2.10 - 7.50 kg) and females weighed 6.31 kg (range 3.75 - 10.50 kg). One hundred eleven were tagged. All fish captured were of mature size. Only one previously tagged fish was captured (tagged at Hess Creek June 5, 1973). None of the 141 sheefish tagged at the Rampart fishwheel in 1972 have yet been recovered. On September 25, eggs could be easily expressed. One sheefish was taken on September 26, and none after that. Since some of the latter sheefish were so close to spawning when taken in the fishwheel it is suggested that the spawning grounds are not too far upriver from Rampart.

The mean length of 1973 Rampart sheefish was similar to both the 1972 and 1962 U. S. Fish and Wildlife Service study averages.

#### Porcupine River Spawning Surveys

Indirect evidence of sheefish spawning in the Porcupine River has been obtained in past years with the findings of young-of-the-year sheefish 145 km

upstream in June of 1971, 1972, and 1973, and August 1970. Test netting during 1973 in the lower 240 km of the Porcupine River took 44 sheefish but most were immature. The only pre-spawning sheefish captured in September, 1973, were taken in an eddy in the Coleen River 6 km below the mouth of the Coleen River on September 22 (4 females and 2 males) and September 26 (62.5 cm) (Table 1). All others were immature or non-consecutive spawners. Nets were moved up into the Coleen River and up the Porcupine River after September 22 in an effort to intercept the spawning fish but no sheefish were taken. The lower 80 km of the Coleen River was surveyed by air on September 19 and the lower 48 km by boat on September 24 but no sheefish were found. The lower 1 km of the Coleen River and the Porcupine River for 1 km below the mouth of the Coleen River were checked for spawning activities the evenings of September 25 - 27 but none were heard. Eggs could be expressed easily from the female caught on September 26 indicating spawning time was approaching. The presence of sheefish in spawning condition 240 km up the Porcupine River (92 km from the Canadian border) on September 26 indicates that at least some of the Porcupine River sheefish spawn in Alaska.

TABLE I. Test netting results Porcupine River, September, 1973.

<u>Date</u>	<u>Location</u>	<u>Net Nights</u>	<u>Fish Captured</u>
17 Sept	Porcupine River Mouth	3	2 SF, 2CS, 1 BWF, 4 HWF, 1 LCI, 8 NP
18 Sept	Black River Mouth	3	1 SF, 2 CS, 2 BWF, 1 NP
19-20 Sept	Ward Camp (144 km upstream)	6	5 SF, 28 CS, 7 BWF, 5 HWF 3 LCI, 4 S, 21 NP
21 Sept	Burnt Paw (230 km)	2	2 SF, 2 CS, 6 BWF, 4 HWF 15 NP
22 Sept	Coleen River Mouth	1	12 GR, 4 NP
22 Sept	Porcupine R. 0.6 km below Coleen River mouth	1	6 SF, 6 CS, 2 BWF, 9 HWF 1 LCI, 5 NP
23 Sept	Lower Coleen River	1	7 GR, 1 NP
23-25 Sept	Porcupine R. 3.2 km above Coleen River Mouth	3	28 CS, 1 SS, 7 HWF, 4 NP
23-24 Sept	81 km up Coleen River	2	no fish
24 Sept	0.8 km up Coleen River	1	10 GR
25 Sept	Porcupine R. 4.8 km above Coleen River	1	1 CS, 6 NP

TABLE 1. (cont.) Test netting results Porcupine River, September, 1973.

<u>Date</u>	<u>Location</u>	<u>Net Nights</u>	<u>Fish Captured</u>
25-26 Sept	16 km up Coleen River	2	no fish
25-26 Sept	17.5 km up Coleen River	2	22 GR, 2 RWF, 3 S
26-27 Sept	0.6 km below Coleen River mouth on Porcupine River	2	2 SF, 1 CS, 3 BWF, 16 HWF, 7 NP
27 Sept	Porcupine 3.2 km below Coleen River mouth	2	1 SF, 7 CS, 1 SS, 3 BWF, 2 NP
28 Sept	Burnt Paw	1	1 NP
<div style="display: flex; justify-content: space-between;"> <div> SF - sheefish  CS - chum salmon  SS - silver salmon  BWF - broad whitefish  S - Longnose sucker </div> <div> HWF - humpback whitefish  LCI - least cisco  GR - grayling  NP - northern pike </div> </div>			

Three of the six sheefish taken on September 22 contained remains of whitefish, Coregonus sp., in their stomachs, the first Alaska recorded incidence of sheefish feeding prior to spawning.

The Sheenjek River was surveyed by plane on September 19 but no sheefish were observed. Residents of Ft. Yukon mentioned that sheefish do not spawn in the Sheenjek River but that sheefish were taken 125 km up the Black River in late September. A search for possible spawning grounds in the upper Black River was not undertaken and residents of Chalkytsik could not provide further information on the question.

#### Middle Yukon River Sheefish Taxonomy

Gill raker and lateral line scale counts of sheefish from the Nowitna, Ray, and Porcupine rivers and Hess Creek were taken to see if they would help in sheefish population separation. Mean lateral line scale counts range from 99.1 - 101.7 and are not significantly different (Table 2). These counts are slightly lower than counts of Kobuk River and Chatanika River (Minto Flats) sheefish but are similiar to counts of upper Yukon River sheefish (Alt, 1969).

Gill raker counts of sheefish from middle Yukon streams are slightly lower than counts from the Kobuk and Selawik areas but almost identical with counts for sheefish from the upper Yukon River and Chatanika River (Minto Flats)

TABLE 2. Gill Raker and Lateral Line Scale Counts for Sheefish From Middle Yukon River Tributaries.

Location	n	L.L. Scales		Gill Rakers Upper Limb		$\bar{x}$	Gill Rakers Lower Limb		$\bar{x}$	Total Count*				
		$\bar{x}$	$\frac{S.D.}{S.E.}$	$\frac{S.D.}{S.E.}$	$\bar{x}$		$\frac{S.D.}{S.E.}$	$\bar{x}$		$\frac{S.D.}{S.E.}$				
Nowitna R.	16	101.4	2.8	.70	.06	6.1	.24	.06	13.4	.61	.14	20.4	.62	.15
Hess Creek	8	100.0	2.9	.54	.19	6.0	.53	.19	13.4	.92	.32	20.5	.76	.27
Ray River	8	99.1	---	---	.07	5.8	.46	.07	14.0	.53	.19	20.8	.46	.16
Porcupine R.	30	101.7	3.3	1.2	.40	6.1	.40	.14	13.6	.77	.14	20.6	.84	.15

\* Total count always one higher than total of lower and upper limb as raker in angle of arch is not counted.

\* Total count always one higher than total of lower and upper limb as raker in angle of arch is not counted.

(Alt, 1969). Mean upper limb counts of middle Yukon River sheefish ranged from 5.8 - 6.1 and lower limb counts ranged from 13.4 - 14.0. Mean total gill raker counts of middle Yukon sheefish range from 20.4 - 20.8 and are not significantly different from each other ( $P < 0.01$ ). Total counts of middle Yukon sheefish agree very closely with sheefish of other Alaskan populations and also with sheefish of the Arctic Siberian Rivers (Alt, 1969). Thus population differentiation based on taxonomic studies cannot be documented.

### Age and Growth

Age determinations were made on a representative sample by size groups of fish from the Nowitna, Ray, and Dall rivers, and all 34 fish taken in the area of the Yukon River haul road (Hess Creek to Stevens Village). The haul road fish taken in September were from the mouth of Hess Creek and Ray River as well as the main Yukon River but were kept separate in the age analysis to see if differences in growth rates between them and the Hess Creek and Ray River summer samples could be detected.

The largest number of fish caught was 386 from the Nowitna River, of which a sample of 149 was used in age determinations. The mean fork length of the Nowitna River fish captured in 1972 and 1973 was 701 mm (range 500 - 930 mm) and the mean weight was 3.97 kg (range 1.00 - 11.1 kg). The mean lengths of the other samples were similar to the Nowitna sample. Very few fish under 470 mm were captured from any of the sampling areas, so fork length at the end of each year of life was back calculated.

Fish of the five groups ranged in age from I to XIV but very few fish less than five years old were captured (Table 3). Since gill nets with small mesh panels were fished at all locations, it is probable that fish less than age V would have been captured if present.

Fish of ages VI to X predominated in all of the samples, with fish of ages VIII and IX being most common.

Since most fish were tagged and released, little information on age at maturity is available. The samples included immature and non-consecutive spawning feeding fish as well as mature potential spawners. In general, earliest age at maturity was VI for males and VII for females but most became mature one year later.

Fish from the Nowitna, Ray, and Dall rivers, Hess Creek, and the Yukon River haul road area have similar growth patterns. The growth of sheefish captured at Rampart (Alt, 1973) also compares closely with growth of these fish.

The fish from the Porcupine River (Alt, 1973), although comparing closely for the first five years, have a divergent growth pattern after age V. At age XI, they are approximately 142 mm shorter than sheefish from the Nowitna River.

It is difficult to separate populations on the basis of age and growth data, although it appears that the Porcupine group may constitute a separate population and those sheefish from the Nowitna, Ray, and Dall rivers,

TABLE 3. Mean Calculated Fork Lengths (mm) At Year-End And Sample Sizes (in parentheses) For Seven Groups of Alaska Sheefish 1970-1973.

Age Group	Nowitna R. (n=149)	Yukon R. at Rampart (n=124) *	Hess Cr. (n=69)	Ray R. (n=60)	Yukon Haul Road (n=34)	Dall R. (n=37)	Porcupine R. (n=102) *
I	149( 0)	139( 0)	137( 0)	146( 1)	133( 0)	146( 0)	142( 2)
II	248( 0)	245( 0)	225( 0)	240( 0)	220( 0)	244( 0)	236( 5)
III	336( 0)	332( 0)	304( 2)	324( 1)	306( 0)	323( 0)	306(10)
IV	416( 0)	406( 0)	385( 4)	403( 0)	385( 1)	407( 0)	375( 3)
V	429( 8)	481( 0)	453( 4)	476( 5)	455( 0)	483( 1)	431(14)
VI	559(25)	549( 2)	519( 6)	540( 6)	523( 7)	546( 1)	485(11)
VII	620(27)	613(21)	583(14)	595( 7)	585( 5)	602( 9)	530(14)
VIII	680(23)	672(33)	642( 9)	637(11)	635( 6)	651(10)	562(21)
IX	722(23)	710(33)	693(10)	672(14)	678( 9)	645(11)	606( 9)
X	768(17)	758(20)	736(10)	711(10)	758( 3)	692( 5)	640( 9)
XI	816(15)	825(10)	773( 6)	732( 5)	779( 2)	-	674( 4)
XII	856( 9)	836( 4)	816( 2)	-	850( 0)	-	-
XIII	907( 1)	929( 1)	863( 1)	-	890( 1)	-	-
XIV	930( 1)	-	894( 1)	-	-	-	-

\* - Alt 1973 b

and Hess Creek constitute a single population. The latter groups may constitute several small local stocks with similar growth patterns because of similar ecological conditions. Further analysis of age and growth data and tag return data may clarify the relationships.

#### Sheefish Electrophoretic Study

Sheefish were collected from the upper Yukon River at the mouth of the Kandik River (n=12), the Yukon River at Rampart (n=15), and the lower Yukon River tributary of the Koyukuk River at Hughes (n=17), in an effort to determine population status of middle Yukon River sheefish through electrophoretic protein analysis (the lower Yukon population spawns in the Koyukuk River). There has been considerable electrophoretic work done on whitefish (e.g., Clayton and Franzin (1970); Clayton et al., 1973). These analyses, which were done by Dr. J. W. Clayton of the Freshwater Institute, Winnipeg, were completed for the enzymes lactate dehydrogenase (LDH), isocitrate dehydrogenase (IDH), glycerol-3-phosphate dehydrogenase (GPDH), and malate dehydrogenase (MDH). The MDH enzyme from red muscle tissue contained many bands in all fish, indicating that sheefish, like other coregonids, have many MDA genes. One fish from Rampart had two additional asymmetric bands indicating this fish has one unusual allele. The sheefish MDH patterns are similar to those reported for king salmon, Oncorhynchus tshawytscha, and the single unusual fish resembled the reported BB/BB<sup>1</sup> phenotype for king salmon. In a breeding experiment conducted with lake whitefish Coregonus clupeaformis, the MDH data did not fit the published model (Clayton and Franzin, 1970). Caution is suggested in interpretation of sheefish MDH phenotypes since it may be that the coregonids have a genetic system for this enzyme that is different from other salmonids. The LDH enzyme from red muscle contained one isozyme in all fish, except one from Rampart, which was heterozygous for this type of gene and contained five asymmetric isozymes. The inference here is that all fish have duplicated genes (H or B), but one fish had one unusual allele. The LDH from white muscle contained five isozymes which indicates duplicated genes (M or A). The enzyme GPDH from white muscle contained one major isozyme in all fish, while the red muscle contained an additional doublet and triplet in all fish, a condition which is common in several other salmonids. The enzyme IDH in red muscle contained three isozymes in all fish, while in the white muscle only two of the red muscle isozymes were visible in all fish.

In summary, inconnu are monomorphic with only the two exceptions from Rampart and as a result there is no evidence in the data either for or against the existence of different populations in the Yukon River.

## R - II - G Distribution, Movements, Age and Growth, and Taxonomic Status of Whitefish in the Tanana Drainage.

### OBJECTIVES

1. To determine whitefish distribution and run timing in the Tanana Drainage.
2. To determine growth and age at sexual maturity.
3. To determine the taxonomic status of whitefish in the Tanana Drainage.

### Distribution Studies

The following streams were test netted during 1973 to determine whitefish presence:

<u>Stream</u>	<u>Date</u>	<u>Whitefish Species Present*</u>
Beaver Creek (middle Yukon)	6-12	BWF, HWF, RWF, LCI,
Chandalar River (middle Yukon)	6-24	BWF, HWF, RWF, LCI,
Coleen River (Porcupine River)	6-21 and 9-25	HWF, RWF
Aniak River (Kuskokwim River)	7-21	HWF, RWF, LCI,

\*BWF - broad whitefish  
HWF - humpback whitefish  
RWF - round whitefish  
LCI - least cisco

### Taxonomy

Gill raker and lateral line scale counts were taken on humpback whitefish Coregonus pidschian, from various middle Yukon River tributaries. Counts have been obtained from humpback whitefish over most of their Alaskan range. Humpback whitefish are most abundant in drainages north of the Alaska Range (e.g. Kuskokwim, Yukon, Kobuk, and Colville rivers) but are also found in the Susitna and Copper River drainages south of the Alaska Range.

Because North American, Siberian, and Alaskan humpback whitefish show much variability from one location to another, there has been much confusion concerning their taxonomy. The reader is referred to McPhail and Lindsey (1970), for a review of humpback whitefish taxonomy.

Current workers agree that biochemical and cytological methods will be the most helpful in solving the taxonomic problems. Electrophoretic protein analysis of muscle tissue of humpback whitefish from the Chatanika River will be carried out by J. W. Clayton at the Freshwater Institute, Winnipeg, Canada.

A summary of gill raker counts from humpback whitefish collected during the first four years of the whitefish study in Alaska is presented in Table 4.

An effort has been made to collect specimens from the entire geographical range of the humpback whitefish in Alaska, but no samples were collected from the lower Yukon River, Bristol Bay, or the Copper River drainage.

The humpback whitefish from coastal areas (Colville River and Imuruk Basin) and the drainages of the Kuskokwim River (Holitna River and Highpower Creek) have lower gill raker counts. Even though the Holitna River capture site and Highpower Creek are 600 km and 1,280 km, respectively, from the ocean, these populations may be anadromous. Humpback whitefish from the Kobuk River (coastal) and the interior drainages of the Chena, Porcupine, and Kandik rivers have slightly higher counts (approximately 23). The modal counts of 21, 22, and possibly 23 indicate Coregonus pidschian (McPhail and Lindsey, 1970). Humpback whitefish of the Copper River drainages (Slana River and Crosswinds Lake) have the highest gill raker counts. The Slana River and Crosswind Lake fish both have modal counts of 25 which would classify them as Coregonus nelsoni.

TABLE 4. Gill Raker Counts For Humpback Whitefish From Various Alaskan Water 1970-1973.

Location	n	$\bar{x}$	S.D.	S.E.	Modal Count(s)
Holitna River	5	21.4	.89	.40	21
Colville River	10	21.5	1.35	.43	22
Imuruk Basin	11	21.9	1.14	.34	22-23
Highpower Cr.	15	21.9	0.99	.26	22
Chena River	8	22.8	1.50	.53	22-24
Kobuk River	6	23.0	0.89	.37	22-24
Porcupine River	27	23.2	0.89	.17	23
Upper Yukon R. (Kandik River)	4	23.3	0.50	.25	23
Nowitna River	20	23.9	1.32	.29	24
Chatanika River	21	24.3	1.23	.27	24
Slana River	3	25.0	0.00	.00	25
Crosswind Lake	16	25.5	.83	.16	25

Humpback whitefish in the middle Yukon River have been considered to belong to the C. nelsoni group (i.e. fish with 23 - 25 gill rakers). In this study, fish from the middle Yukon River near Ruby had a modal count of 24 gill rakers while fish from the upper Yukon River area (Porcupine and Kandik Rivers) had modal counts of 23. Two tributary rivers of the Tanana River near Fairbanks (Chena and Chatanika rivers) had dissimilar mean counts (22.8 and 24.3, respectively). The hypothesis that the intermediate number of gill rakers in middle Yukon River fish (i.e. 24 - 25) is caused by hybridization of low gill raker forms from the lower Yukon River (C. pidschian) with high gill raker forms from the upper Yukon River (C. clupeaformis) does not appear to be supported. In fact, humpback whitefish from the upper Yukon River have lower counts than fish from the Nowitna River (1,100 km downstream). Therefore, all Alaskan humpback whitefish examined can be classified as C. pidschian.

Situations have been found where morphologically and ecologically distinct sympatric groups of humpback whitefish, one with high gill raker counts and the other with low counts, are found in the same lake or stream (Lindsey 1963; Kennedy 1943, 1953). Similar situations have not been found in Alaska.

I have not examined any Alaskan humpback whitefish with modal counts of 26 or higher, although no fish were examined from the Susitna or Alsek drainages. Susitna drainage fish are reported to be Coregonus clupeaformis (McPhail and Lindsey, 1970).

#### Age and Growth

Scales of humpback whitefish collected during the first four years of the study have been examined for age determination. A detailed analysis of these data is being prepared for publication in appropriate scientific journals. Table 5 gives fork lengths at the end of each year of life for Alaskan humpback whitefish. In general, age at sexual maturity is 5 - 6 years for males and 6 - 7 years for females. Some Chatanika River fish may reach sexual maturity one year earlier and some individuals in the Porcupine River populations may not mature until age 7 or 8.

TABLE 5. Mean Fork Length (mm) of Humpback Whitefish From Various Waters of Alaska, 1970-1973.

Location	n	Age at Capture											
		I	II	III	IV	V	VI	VII	VIII	IX	X	XI	XII
Colville R.*	45	121	147	215	---	274	311	325	380	383	401	---	
Kobuk River	27	---	---	---	---	---	315	347	358	378	405	430	438
Agiakpuk R.	46	---	---	210	240	257	314	338	---	346	410	---	
Koyuk River	3	---	---	---	255	---	305	320	---	---	---	---	
Unalakleet	2	---	---	---	305	---	---	350	---	---	---	---	
Kandik River	6	---	120	---	200	---	---	---	330	---	400	---	
Porcupine R.	78	110	153	205	256	352	390	416	430	447	452	475	540
Dall River	5	---	---	---	---	320	---	420	---	447	---	---	
Ray River	31	111	166	217	242	---	390	---	432	---	485	500	
Hess Creek	17	122	167	212	---	252	---	---	---	---	465	450	
Nowitna R.	47	---	---	232	251	339	370	404	429	446	479	485	
Chena River	8	193	213	250	275	365	---	---	---	---	---	---	
Chatanika R.**104	120	120	194	249	301	349	385	415	442	465	486	512	532
Hightower Cr.	11	---	---	---	---	---	396	373	---	450	---	---	
Holitna River	14	---	---	---	---	---	---	383	427	441	485	531	

TABLE 5. (cont.) Mean Fork Length (mm) of Humpback Whitefish From Various Waters of Alaska, 1970-1973.

Location	n	Age at Capture											
		I	II	III	IV	V	VI	VII	VIII	IX	X	XI	XII
Crosswind Lk. 17 (Glennallen)	17	---	---	---	303	312	346	---	383	450	---		
Swan Lake (Cordova)	2	---	---	---	320	---	---	425	---				

\*From Kogl 1971  
 \*\*Back-calculated data from Alt, 1971.

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